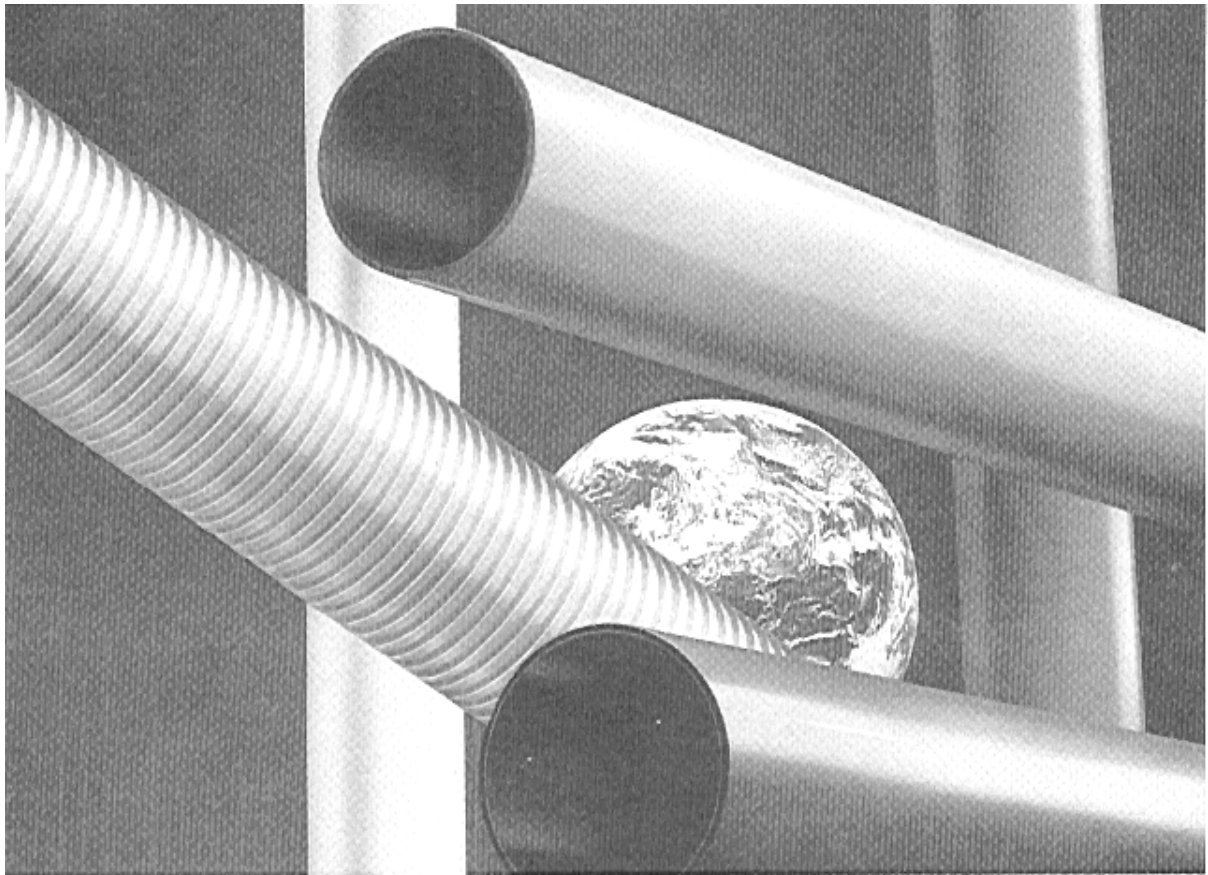


# **Installation Notes**

of Different Types of Corrosion Resistant Pipe Materials  
as Inside Service in Buildings



**Water Supplies Department**  
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## Preface

These notes are meant to provide plumbers/installers with some practical information and the practices to be followed in the application and installation of the corrosion resistant type of pipe materials approved by the Water Authority but are not intended to serve as a design guide or a technical pipe laying manual. It is therefore advisable for the plumbers/installers to consult the suppliers on the properties and characteristics of the pipe material should they wish to use any particular type of pipe materials.

The Office of the Water Authority wishes to thank the following organisations for their efforts and valuable contributions, who have kindly agreed to join a Working Party in preparing the notes:

Hong Kong Plumbing & Sanitary Ware Trade Association

Hong Kong Licensed Plumbers Association

The Institute of Plumbing - Hong Kong Council

Hong Kong Plumbing General Union

The Office of the Water Authority also wishes to thank the Hong Kong Institute of Architects and the Hong Kong Institution of Engineers who have offered their comments on the notes.

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## **Installation Notes**

### **Lined Galvanized Steel Pipe for Cold and Hot Water Services**

- Since 23 July 1991, lined galvanized steel pipes are allowed to be used on cold water services in Hong Kong subject to the following conditions:
  - (a) the steel pipes and fittings shall be galvanized and shall comply with BS 1387 for medium tubes and tubulars and with BS 143 and BS 1256 for malleable cast iron and cast copper alloy pipe fittings respectively;
  - (b) the protective lining material may be made up of epoxy, unplasticised polyvinyl chloride, or polyethylene conforming to a recognised National/International standard which is acceptable to the Water Authority; and
  - (c) the material for the protective lining shall also be tested for suitability for use in potable water supply and comply with the requirements of BS 6920 - "Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water".
- The PE or PVC-U lining has a lower frictional loss than metallic pipes. The  $c$  values for plastic (PE or PVC-U), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- A band saw with plenty of cooling water shall be used to cut and make the pipe ends smooth and clean. After cutting, the burr of internal lining shall be removed with a reamer or scraper. The pipe shall not be cut by gas, arc or high-speed grinder as the lining inside will be damaged by the high temperature.
- Installation, jointing, storage and handling of the pipes and fittings shall be in accordance with the manufacturer's recommendations.
- Pipes shall be jointed with screwed fittings with pipe threads complying with BS 21. Screwed joints shall have tapered threads and shall be made with approved jointing material. Where the cutting of threads removes the galvanizing, an anti-corrosive sealing compound shall be applied to restore the integrity of the protective finish.
- For lined galvanized steel pipe, elbows instead of bends can be used.

- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. Alternative arrangement for meter position can also be accepted provided that the water meters can be installed and removed with ease. The meter position for meter of all sizes shall also be similarly provided with corresponding fittings of appropriate sizes.

### **PB Pipe for Hot and Cold Water Services**

- PB pipes are flexible and can be available in straight or coil form.
- The coefficient of thermal expansion of PB is  $(1.3 \times 10^{-4} \text{mm mm}^{-1} \text{ per } ^\circ\text{C})$ , i.e., the linear expansion for PB pipe is approximately 13mm per  $10^\circ\text{C}$  temperature change for every 10 meters of pipe. Allowance shall be made for free thermal movement in a long run of piping especially in hot water systems. Expansion loop in the form of an Omega shape or S snake shape shall be formed for a long straight run of pipe.
- The PB pipe has a lower frictional loss than metallic pipes. The c values for plastic (PB), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- The system must be adequately supported to prevent distortion. Maximum spacing between horizontal supports and vertical run shall be as shown in table 2 of BS 5955 : Part 8.
- Pipe supports shall be designed to provide a permanent fixing. Where fittings such as valves and manual controls are used, these shall be firmly anchored so as to minimize any turning moment imparted to the pipe by operation of handwheel, levers etc. It is recommended that pipe clips made from plastics materials are used, preferably encompassing the pipe by more than 80% of its circumference.
- All joints shall be made in accordance with the instructions of the fittings manufacturer or in the absence of instructions, in accordance with the procedures detailed in Appendix B of BS 5955 : Part 8. It is noted that it is possible to joint polybutylene pipes by thermal fusion. However, BS 7291 Part 2 has not yet be amended to include any material-related requirements for such joints and fittings. In general, PB pipe can only be jointed together by mechanical joints.

- PB pipework shall not be connected directly to a boiler or circulator. In this situation it is recommended to use a 350mm (or more) length of copper connection pipe for heat dissipation. Similarly, do not let PB come close to articles which are likely to become very hot.
- PB pipes have some degree of flexibility and may be cold bent to a minimum radius as specified by the manufacturer to accommodate contours and curvatures. If the manufacturer does not specify the minimum cold bend radii, the minimum cold bend radii shall be in accordance with table 3 of BS 5955 : Part 8. It is necessary to support the cold bend in order to maintain its configuration. Where bend clips are available, these should be used to hold the bend.
- Using the thermoplastics nature of the material, tighter bends can be formed in PB by hot bending. This is, however, a skilled operation and is not recommended for use on site.
- When an installation is completed it should always be thoroughly flushed through with water and fully pressure tested in accordance with Appendix C of BS 5955 : Part 8 before commissioning.
- PB is a non-conductor of electricity and the system must not be used as electrical earthing point.
- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. The meter position for meter of all sizes shall also be similarly provided with corresponding fittings of appropriate sizes.
- BS 5955 : Part 8 specifies methods and gives guidance for the installation of polybutylene (PB) pipes and associated fittings compatible with the scope of BS 7291.

### **PE-X Pipe for Hot and Cold Water Services**

- The base material of PE-X is a high-density polyethylene of high molecular weight. The term crosslinking is used to describe the chemical linking of the PE molecules into a three-dimensional network. Because of this cross-linking, the material is capable of withstanding higher temperature. There are various

cross-linking methods for PE moulding or extrusion either alone or in combination with other plastic materials, e.g. by radiation, peroxide, etc.

- PE-X pipes are flexible and can be available in straight or coil form.
- The coefficient of thermal expansion of PE-X is ( $2 \times 10^{-4} \text{mm mm}^{-1} \text{ per } ^\circ\text{C}$ ), i.e, the linear expansion for PE-X pipe is approximately 20mm per  $10^\circ\text{C}$  temperature change for every 10 metres of pipe. Allowance shall be made for free thermal movement in a long run of piping especially in hot water systems. Expansion loop in the form of an Omega shape or S snake shape shall be formed for a long straight run of pipe length.
- The PE-X pipe has a lower frictional loss than metallic pipes. The c values for plastic (PEX), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- The system must be adequately supported to prevent distortion. Maximum spacing between horizontal supports and vertical run shall be as shown in table 2 of BS 5955 : Part 8.
- Pipe supports shall be designed to provide a permanent fixing. Where fittings such as valves and manual controls are used, these shall be firmly anchored so as to minimize any turning moment imparted to the pipe by operation of handwheel, levers etc. It is recommended that pipe clips made from plastics materials are used, preferably encompassing the pipe by more than 80% of its circumference.
- All joints shall be made in accordance with the instructions of the fittings manufacturer or in the absence of instructions, in accordance with the procedures detailed in Appendix B BS 5955 : Part 8. In general, PE-X pipe can only be jointed together by mechanical joints.
- PE-X pipework shall not be connected directly to a boiler or circulator. In this situation it is recommended to use a 350mm (or more) length of copper connection pipe for heat dissipation. Similarly, do not let PE-X come close to articles which are likely to become very hot.
- PE-X is a non-conductor of electricity and the system must not be used as electrical earthing point.
- PE-X have some degree of flexibility and may be cold bent to a minimum radius as specified by the manufacturer to accommodate contours and curvatures. If the manufacturer does not specify the minimum cold bend radii, the minimum cold bend radii shall be in accordance with table 3 of BS 5955 :

Part 8. It is necessary to support the cold bend in order to maintain its configuration. Where bend clips are available, these should be used to hold the bend.

- Using the thermoplastics nature of the material, tighter bends can be formed in PE-X by hot bending. This is, however, a skilled operation and is not recommended for use on site.
- When an installation is completed it should always be thoroughly flushed through with water and fully pressure tested before commissioning.
- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. The meter position for meter of all size shall also be similarly provided with corresponding fittings of appropriate sizes.
- BS 5955 : Part 8 specifies methods and gives guidance for the installation of crosslinked polyethylene (PE-X) pipes and associated fittings compatible with the scope of BS 7291.

### **Hunter PVC-C Pipe for Hot and Cold Water Services**

- Chlorinated Polyvinyl Chloride (PVC-C) pipe is produced by adding extra chlorine atoms to PVC molecules. The resultant polymer has a higher density and can be used at higher service temperatures.
- The Hunter-Genova (PVC-C) pipe and fittings are manufactured to the America specifications of ASTM D 2846, requiring a minimum hydrostatic burst strength of 100 psi at 82°C and 400 psi at 20°C for continuous use for 50 years. This system has also been approved by the Water Research Centre (WRc) in U.K. for use above ground and in contact with cold water or continuously in contact with hot water withstanding a maximum working pressure of 15 bar at 20°C and 2 bar at 85°C.
- PVC-C material and the Nova-Weld C solvent cement used in the Hunter-Genova System pass all the WRc requirements for toxicity, taste and resistance to microbiological growth. It has been examined, tested and accepted by the WRc to have complied with the U.K. Water Fittings Byelaws and Regulations when correctly installed.



- Hunter-Genova (PVC-C) Pipe and Fittings is of tan colour to BS 4800, 10C31.
- Hunter-Genova (PVC-C) pipe is available in 15, 22 and 28mm sizes and supplied in standard length of 3m. A full range of fittings is available to enable connections be made to other materials easily.
- The coefficient of thermal expansion of PVC-C is  $(0.65 \times 10^{-4} \text{ mm mm}^{-1} \text{ per } ^\circ\text{C})$ , i.e., the linear expansion for PVC-C pipe is approximately 6.5mm per  $10^\circ\text{C}$  temperature change for every 10 meters of pipe. Allowance shall be made for free thermal movement in a long run of piping especially in hot water systems. Expansion loop in the form of an Omega shape or S snake shape shall be formed for a long straight run of pipe.
- The PVC-C pipe has a lower frictional loss than metallic pipes. The c values for plastic (PVC-C), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- The system must be adequately supported to prevent distortion. Maximum spacing between horizontal supports and vertical run shall be 500mm and 1m respectively.
- Pipe supports shall be designed to provide a permanent fixing. Where fittings such as valves and manual controls are used, these shall be firmly anchored so as to minimize any turning moment imparted to the pipe by operation of handwheel, levers etc. It is recommended that pipe clips made from plastics materials are used, preferably encompassing the pipe by more than 80% of its circumference.
- The method of jointing is similar to PVC-U system. It is not recommended to substantially bend PVC-C pipe, and therefore, all changes in direction must be made by using the appropriate fittings.
- Solvent cementing of PVC-C should not be made in wet conditions, or at temperatures below  $0^\circ\text{C}$  or above  $40^\circ\text{C}$ . The joints should be left undisturbed for 8 hours before applying the working pressure. To ensure that they have gained sufficient strength, a drying time of 24 hours is required before testing to 1.5 times working pressure.
- PVC-C pipework shall not be connected directly to a boiler or circulator. In this situation it is recommended to use a 350mm (or more) length of copper connection pipe for heat dissipation. Similarly, do not let PVC-C come close to articles which are likely to become very hot.

- When an installation is completed it should always be thoroughly flushed through with water and fully pressure tested in accordance with Appendix C of BS 5955 : Part 8 before commissioning.
- PVC-C is a non-conductor of electricity and the system must not be used as electrical earthing point.
- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. The meter position for meter of all sizes shall also be similarly provided with corresponding fittings of appropriate sizes.
- BS 5955 : Part 8 specifies methods and gives guidance for the installation of chlorinated polyvinyl chloride (PVC-C) pipes and associated fittings compatible with the scope of BS 7291.

### **ABS Pipe for Cold Water Services**

- ABS pipes are made from an Acrylonitrile Butadiene Styrene formulation. The copolymeric system can be blended to yield the optimum balance of properties suited to a selected end use. Acrylonitrile imparts chemical resistance and rigidity. Butadiene endows the product with impact strength and toughness while Styrene contributes to ease of processing.
- ABS is classified as a rigid thermoplastic over its working temperature range, -40°C to + 80°C. The system can withstand a minimum continuous working pressure of 10 bar at 20°C for 50 years. The material is tough and has high impact strength and good chemical resistance.
- The pipes are jointed by cold solvent welding (solvent cement).
- ABS pipes and fittings are accepted by WRc. According to the available information, there is no British Standard Specification and other National Standards for this kind of pipe material except a BS for industrial use - BS 5391 - Specification for Acrylonitrile-butadiene-styrene (ABS) pressure pipe, Part 1 - Pipe for industrial uses.

- The coefficient of thermal expansion of ABS is  $(1.01 \times 10^{-4} \text{ mm mm}^{-1} \text{ per } ^\circ\text{C})$ , i.e., the linear expansion for ABS pipe is approximately 10.1mm per  $10^\circ\text{C}$  temperature change for every 10 metres of pipe. Allowance shall be made for free thermal movement in a long run of piping especially in hot water systems. Expansion loop in the form of an Omega shape or S snake shape shall be formed for a long straight run of pipe.
- The ABS pipe has a lower frictional loss than metallic pipes. The  $c$  values for plastic (ABS), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- The system must be adequately supported to prevent distortion. With increased temperature, pipe rigidity decreases thus necessitating more frequent support. Therefore, the maximum spacing shall be in accordance with the instructions of the manufacturer. It is recommended that pipe clips made from plastics materials are used, preferably encompassing the pipe by more than 80% of its circumference.
- Pipe supports shall be designed to provide a permanent fixing. Where fittings such as valves and manual controls are used, these shall be firmly anchored so as to minimize any turning moment imparted to the pipe by operation of handwheel, levers etc.
- The method of jointing is similar to PVC-U system. It is not recommended to substantially bend ABS pipe, and therefore, all changes in direction must be made by using the appropriate fittings.
- Solvent cementing of ABS should not be made in wet conditions. 24 hours drying time must be allowed before applying full working pressure. The joint may be used earlier at lower pressures but not within 4 hours of completing the jointing procedure.
- When an installation is completed it should always be thoroughly flushed through with water and fully pressure tested in accordance with the recommendation of the manufacturer before commissioning.
- ABS is a non-conductor of electricity and the system must not be used as electrical earthing point.
- ABS suffers only slight surface degradation on prolonged exposure to direct sunlight. Loss of properties can be substantially reduced by the simple precaution of painting the surface with white paint.

- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. The meter position for meter of all sizes shall also be similarly provided with corresponding fittings of appropriate sizes.

### **KITEC Pipe for Hot and Cold Water Services**

- KITEC pipe was invented by a British expert Mr. Izhak Barnoach and the patent was owned by a Dutch Company Kitechnology B.V.
- KITEC pipe is a coextruded crosslinked polyethylene or high density polyethylene composite pressure pipe with a welded aluminum tube reinforcement between the inner and outer layers. The inner and outer layers are made of crosslinked polyethylene or high density polyethylene and are bonded to the aluminum tube by a melt adhesive.
- Orange and Black KITEC pipe and connectors are for use in above-ground hot and cold water services, including potable water. Orange KITEC pipe should not be used for installations exposed to direct sunlight. Black KITEC pipe can be used instead.
- Blue KITEC pipe and connectors are for use in above-ground cold water services, including potable water.
- Both systems have been examined, tested and accepted by WRc to have complied with the U.K. Water Fittings Byelaws and Regulations when correctly installed.
- The pipe is supplied in coils of 50m or 100m for the 25mm size, in coils of 100m or 200m for the 16mm and 20mm size, and in coils of 200m or 400m for the 14mm size. Straight 4m length of pipe are also available in all sizes up to 25mm O.D.
- The coefficient of thermal expansion of KITEC pipe is  $(1.17 \times 10^{-4} \text{ mm mm}^{-1} \text{ per } ^\circ\text{C})$ , i.e., the linear expansion is approximately 11.7mm per 10°C temperature change for every 10 metres of pipe. Allowance shall be made for free thermal movement in a long run of piping especially in hot water systems. Expansion loop in the form of an Omega or S shape shall be formed for a straight long run of pipe.

- The KITEC pipe has a lower frictional loss than metallic pipes. The c values for plastic (PE or PEX), metallic and A.C. pipes in the Williams and Hazen Formula are 150, 125 and 110 respectively.
- KITEC pipes shall be supported at regular intervals using pipe clips recommended by the supplier. Maximum spacing between horizontal and vertical supports shall be as shown below:

Recommended spacing of pipe supports		
Nominal Pipe Size	Horizontal Run (mm)	Vertical Run (mm)
1014 ID 10mm x OD 14mm	800	1000
1216 ID 12mm x OD 16mm	800	1000
1620 ID 16mm x OD 20mm	800	1000
2025 ID 20mm x OD 25mm	1000	1200

- KITEC pipes/tubes shall not be threaded. They shall not be solvent welded nor glued. Each jointing incorporates a purpose made KITEC connector at one end and a male BSP thread at the other. Each connector shall stamped with the size and the KITEC symbol. The connectors are manufactured from brass to Table 7 of B.S. 864 : Part 2 - Specification for capillary and compression fittings for copper tubes.
- Pipe supports shall be designed to provide a permanent fixing. Where fittings such as valves and manual controls are used, these shall be firmly anchored so as to minimize any turning moment imparted to the pipe by operation of handwheel, levers etc.
- KITEC pipework should not contain any joints below floor level. When installing pipes in solid floors or walls, suitable ducting or chasing must be used to provide access to pipe work for repair or replacement.
- A pipe cutter and a special flaring tool is required for the preparation of the joint.
- KITEC pipes can be bent manually or with a suitable bending spring for directional changes but the radius of curvature shall not be less than five times the diameter of the pipe or tube.
- KITEC hot water systems are not intended to be used for temperatures above 82°C. When making a connection to a heated cylinder where temperature

could regularly exceed 82°C it is recommended that a short length of metal pipe be installed between the water heater outlet and the pipe system.

- Crosslinked polyethylene and high density polyethylene are insulating materials and hence KITEC pipes must not be used for earthing of electrical equipments.
- The meter position for 15mm diameter meter shall be constructed to include 20mm x 15mm brass bushes, or reducers, at both sides of the meter position with a 200mm (clear effective length) distance piece of 15mm G.I. tube placed in between. A brass longcrew (connector) shall be provided immediately after the bush or reducer at the delivery side. The meter position for meter of all sizes shall also be similarly provided with corresponding fittings of appropriate sizes.

### **MDPE/HDPE Pipe for Cold Water Services**

- Please refer to the requirements of CP 312 - Code of Practice for Plastic Pipework published by the British Standards Institution and Manual for the design, Installation and Operation of MDPE pipe system for water supply distribution published by WRc on the design, installation and operation of MDPE/HDPE pipe systems.